ECE 403:

Senior Design II

Options Considered Document

9/29/09

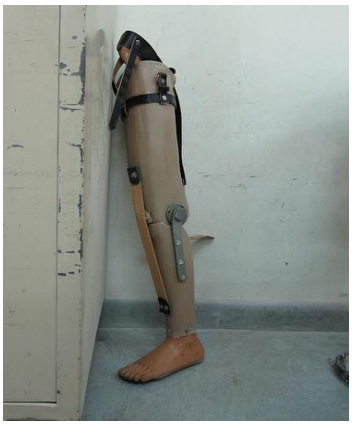
John Xu

Jacob Wagner

Introduction:

The Jaipur foot project consists of improving the current version of the prosthesis appendage, the Jaipur foot. This project is focused on implementing an electrical system into the leg in order to obtain a more natural gate when in use. The system will require sensors embedded into the foot in order to relay information to a controller that will control an actuator to assist in the movement of the knee joint. This project will also require an energy source and is very concerned on the cost aspect of the system. This project will require extensive collaboration with a team of Mechanical Engineering students from MNIT in India.

Previous Work:



First developed in Jaipur, India 1968. It's known as the cheapest artificial leg in the world. Previously Stanford University and M.N.I.T. worked on the mechanics of the foot. However there was no electrical components added to the leg.

Design Options and Selected Approach:

<u>System Sensors</u>

Pressure sensors placed on sole of foot/ inside foot
Advantage:

- We'll know what is happening to the foot at all times

Disadvantage:

- Wear out quicker
- possibly consumes more energy

Pedometer
Advantage:

- Lower energy consumption

- longer life
- simpler to implement

Disadvantage:

- timing issues when initially starting to walk

Energy

Solar energy
Advantage:

- We don't have to charge the power system too often comparing with conventional batteries.

Disadvantage:

- it's going to affect the outside appearance of the leg
- possibly cost more
- It also needs the exposure to the efficient sun light.

Rechargeable battery
Advantage:

- common to everybody
- easy access to recharge battery

Disadvantage:

- has to recharge the batteries periodically

Microcontroller

PIC
Advantages:

- Simpler to implement
- More precision of movement
- Easily adjusted
- Faster communication

Disadvantages:

- Added cost

- Additional Energy

No Microcontroller
Advantages:

- Saves on cost
- System will use less energy

Disadvantages:

- More complex circuitry
- Will only let us turn on/off the actuator
- The actuator must completely depend on the sensors

Joint Movement

Actuators
Advantages:

- More energy efficient
- Simpler to implement

Disadvantages:

- Higher cost
- Larger then we would like
- Less Precision
- Slower response time

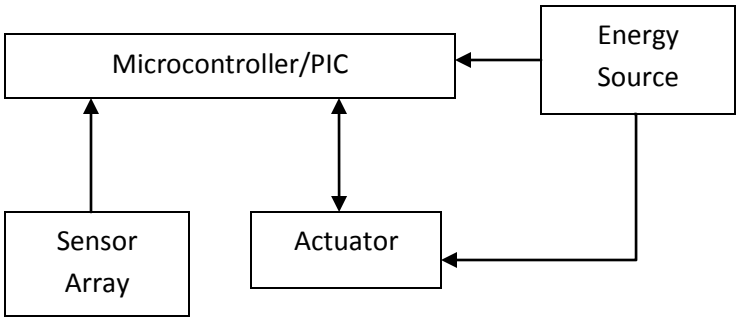
Servo Motor
Advantages:

- Low cost
- Lighter (this specific model is)
- Higher Level of Precision

Disadvantages:

- More difficult to implement in knee joint
- Less energy efficient

Block Diagram of System:



Budget:

At this stage, we are not really sure about how much exactly the cost for the project. We are going to have sensors and actuators; also we are going to build a PCB board. The software we are going to use is from the previous design projects, so there won't be any cost to it. The estimated cost is about $1000.

Part	Quantity	Retail Cost	Expected Cost	Total Cost	Notes
Force Sensors	12	$5.00~15.00	8.00	96.00	We are not sure the specific sensors we will need/test
PICxxxx microcontroller	2	$8.97	$0.00	$0	Free samples
Actuators	4	~$75.00-100.00	100.00	400.00	We are unsure of the actual requirements of the actuators
Batteries	4	~$50.00	50.00	200.00	
Battery-Pedometer	4	1.00	4.00	4.00	GP CR2032 Lithium Coin Cell 3
Pneumatic System	1	?	?	?	Not sure we will need this
Servo Motor	3	12.00	12.00	36.00	Not sure we will need this
PCB	2	~$25.00	25.00	50.00	
			Total	**$786.00**	

Summary:

Our ultimate goal is to implement the new control device into the foot by the end of the school year. By the end of the semester we are planning to have sensors and actuators on the foot, measurements of the foot will be taken too. Then the functionality of the electronics will be tested. The following semester we are going to focus on the energy supply for the foot and how to implement the device into the foot without changing the existing product. The foot will be able to move or twist more easily, have a more natural gate.
The dominate criteria of this project is the cost, after all the testing of the device we have to make it as much economic as possible. Also we need to consider the size or dimensions of the parts can be used on the foot, since the appearance of the foot should not be changed.

Note

At this time we are still in the process of setting up regular communication with our partner group in India. We are working on setting up multiple lines of communication, however at this stage that portion of the project is incomplete and as such we are still uncertain about some aspects of the project and are still gathering the necessary information.